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A BIOLOGICAL EVALUATION OF FOREST PEST CONDITIONS AT THE CALDWELL BUTTE EAGLE ROOST AREA, LAVA BEDS NATIONAL MONUMENT

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ABSTRACT

The Caldwell Butte eagle roost area and adjacent sites at Lava Beds National Monument were examined for current and potential pest problems which may affect management objectives. Tree mortality was minimal, and confined to old dominants and small trees in overstocked portions of the stand. Activity of bark and engraver beetles was present, but at very low levels. No evidence of root diseases were found. Two management alternatives, involving no action or vegetation management activities directed toward maintaining tree and stand vigor, are discussed.

INTRODUCTION

About 500 bald eagles, Haliaeetus leucocephalus, overwinter in northern California. Many use pines in the Lava Beds National Monument for perches and communal roosts when not foraging at the nearby Tule Lake National Wildlife Refuge. The continued availability of these trees is pertinent to sustaining the population of this endangered species. Thus, pests that threaten the existance of particular trees, and the general vigor of the Monument pine stands, are germane to vegetation management directed toward providing a habitat favorable to these birds. In our role of technical advisors to the National Park System, Forest Pest Management was requested to examine the communal roost area near Caldwell Butte and adjacent areas as part of the formulation of a Management Plan.

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John Dale, Entomologist, and John Kliejunas, Plant Pathologist, met with Stephen Underwood, Resource Management Specialist for the Monument, on February 24, 1987. The day was spent examining the roost area and pine stands south of Caldwell Butte (Fig. 1, see Appendix). A brief review was given to historic files and reports on file in the headquarters library. A close-out session with Superintendent Doris Omundson was held.

OBSERVATIONS

The forest to the south of the Caldwell Butte cinder cone consists of ponderosa pine (Pinus ponderosa), with a scattering of western juniper (Juniperus occidentalis). The area of pine cover may have been more extensive before severe tree mortality occurred in the early 1930's. The fallen remains of the pine mortality of this period are most visible on the northeast side of the butte, where a young stand of ponderosa pine is beginning to dominate.

The stocking within the forested area is quite variable, ranging from large openings with no trees to dense clusters of small pole-size pines of up to 220 square feet or more of basal area. Tree sizes range from small poles to large dominants about 300 years of age. Heights are not great due to the climatic and edaphic limitations of the site. However, some of the smaller trees are making good height growth (1 to 2 feet/year) when situated with a minimum of competition from other trees and shrubs. The latter consist of mountain mahogany, bitterbrush, rabbitbrush, sagebrush, manzanita, and other shrubs and herbaceous species, and are quite abundant, as witnessed by the very large number of deer on the Monument.

Soils are generally thin and of a pumice origin, but certain sites may be deeper, giving a "flower pot" effect for survival and growth. The droughty soils and low precipitation levels (11 to 12 inches per year) make the site marginal for ponderosa pine. To the north, east, and west of Caldwell Butte, junipers and mountain mahogany dominate and few pines maintain their presence. Droughts are frequent. Mt. Dome, eight miles to the northwest, has one year in four with less than 10 inches of precipitation, and one-third of all years has less than average rain and snowfall.

The marginal character of the site apparently was the "cause other than insects," that was considered responsible for the tree mortality of "young and old" ponderosa pine in the early 1930's (letters of S. W. Allen to J. D. Coffman, Chief Forester of the Park Service, in which Allen refers to his correspondence with Dr. J. M. Miller and Dr. K. A. Salman; on file, Lava Beds National Monument). Those viewing the mortality at that time found western pine beetle (Dendroctonus brevicomis), mountain pine beetle (D. ponderosae), flatheaded borers (Melanophila californica), and pine engravers (Ips spp.) present, but agreed that the ultimate "... cause for the wholesale loss of trees lies in another direction".

Recent tree mortality was widely scattered and appeared to be largely confined to old dominants of considerable age and small trees in dense clusters. The inner-bark of the smaller trees was quite thin at the time of mortality. Only old galleries of mountain pine beetle were found under the bark of the small dead trees, while galleries of flatheaded borers were found in the large trees. It was assumed that attacks of the mountain pine beetle, and possibly

the western pine beetle, occurred higher up the bole of larger trees, but there were no outward signs of their presence, such as pitch tubes or flaking of the bark by woodpeckers seeking brood. Many of the larger snags had been dead for some time and little remained of their branches and limbs. These trees were loosing their utility as roosts. The limited amount of top-kill observed in the smaller trees was attributed to pine engravers (Ips spp.).

Many of the larger trees appeared to be in a state of decline, having dead branches, poor needle color, and poor needle retention leading to a tufted appearance. A few were dying a section at a time from the top down as pine engravers, and possibly mountain pine beetle, took their toll (Fig. 2, see Appendix).

Signs of annosus root disease (caused by Fomes annosus) were not found in any of the declining or dead trees, nor did we observe the typical characteristics of a root disease center - an expanding open area with recent mortality at its edges. Stumps were not present in the area and there was no evidence that cutting had taken place prior to the establishing the Monument within the Park Service System.

Black stain root disease (caused by Ceratocystis wageneri) is known to occur on the Modoc National Forest near the Lava Beds National Monument. However, we could not find signs characteristic of this disease in the Caldwell Butte stand.

MANAGEMENT ALTERNATIVES

Pest problems in the area examined are currently minimal. Evidence of root disease was not found. Activity of bark and engraver beetles in 1986 was so low as to be almost absent. However, the historical record and evidence on the ground indicate that bark beetles could be a problem in maintaining an adequate number of the perch and roost trees that are among the essential characteristics of a winter concentration area.

1. No Action. Scattered top-kill of smaller, non-roost pines will continue. Prevalence of such attacks will vary from year to year in relation to climate and beetle abundance. Those roost trees currently in a state of decline will continue to decline as portions of their crowns weaken and are then killed by the work of pine engravers, mountain pine beetle, and the California flatheaded borer. This may initially increase their utility as roost trees because the dead branches intermixed with live branches will allow for flight manuverability as well as thermal cover from chilling winds. The process of decline can occur over a long period of time. However, the objective is not only to maximize roost tree longevity; more importantly, it involves recruitment of trees from younger age classes over the same time interval as present roost trees lose their utility as roost and perch trees.

This alternative may not provide the number of roost trees necessary to maintain the current winter habitat. The eagle population, or a portion of the population, may choose to move to another area if the number of roost trees declines or the preferred characteristics of the Caldwell Butte roost areadeteriorate. Alternate areas may not be as beneficial to the population as

the present status of Caldwell Butte. For example, the birds might have to fly farther to reach their feeding areas.

Currently there seems to be an insufficient number of mature trees to replace the veterans that serve as roosts along with some snags. This can only be determined by an intensive survey for determining the distribution and frequency of tree size classes. But if this cursory observation is correct, this alternative will not maintain the current number of roost trees. Whether or not the current number is more trees than really necessary is not within the perview of this report.

2. Management of Vegetation. No tree lives forever, even at low levels of insect and disease activity. Management directed toward maintaining tree and stand vigor will preserve the present roost and perch trees as long as possible as well as allow for the recruitment of new trees into these classes. Maintaining healthy, vigorous stands not only allows for recruitment, but would help maintain the visual isolation of the roost area.

a. Reduce competition around selected trees. Present roost trees and snags have been mapped and tagged. Potential recruits in younger age classes could be similarly located. Removal of vegetative competition from around these selected trees would improve their longevity and growth by allowing them to capture more of the water and nutrient resources of the site. Impacts would be localized and the area would become a mosaic of managed and unmanaged vegetation. The selected trees would grow to roost standards and serve as replacements as older trees die and snags loose their limbs.

Fuel loading would be less than with widespread thinning, but some form of slash treatment would be necessary. Fresh pine slash caused by thinning or winter storm breakage can be modified in a number of ways to make it unsuitable for pine engraver breeding. One approach to minimizing damage is to schedule slash-generating activities mostly between mid-July and late-December, when the slash has a high probability of drying out, heating up, or spoiling before the beetles can complete their development. Utilization of the cut material to the smallest possible diameter will minimize the amount of breeding material available to engraver beetles. If green pine slash must be created during the spring and early summer, slash treatments are available to prevent the buildup of pine engraver populations. Because pine engravers can complete their development in about a month under ideal conditions, treatment should be carried out soon after cutting to be effective.

Slash treatment methods which generally work well include chipping, lopping and scattering slash in sunny areas to heat it up, crushing or mashing slash with logging equipment to make it unsuitable for pine engraver breeding, or piling and burning the slash within a month of cutting. Broadcast burning the slash might work if it could be done without damaging the residual stand. A method which has worked during the summer in hot climates is to pile slash in a sunny area and tightly cover the pile with clear plastic. If the temperature under the bark of slash in all parts of the pile reaches 120^{o}F, all brood currently in the pile will be killed. Lower temperatures will not be effective and, where successful, this method will not prevent reinfestation of slash piles. Because most pine engraver attacks occur within a quarter-mile from the location where the beetles emerged, high value pines can be given some protection by removing fresh pine slash to areas which do not have pines.

Two practices which should generally be avoided are piling fresh pine slash without further treatment, and allowing slash to touch or remain near valuable leave trees.

b. Reduce competition throughout the stand. This alternative would improve the vigor of the entire stand by reducing competition. The selection of recruits to eventually replace roost trees need not occur prior to thinning in this instance. Growth response would indicate which trees would be selected.

More slash would be created than with a. The previous description of slash treatment would apply in this alternative also. Once the material was unsuitable as host material for the engravers, subsequent creation of small piles would create shelter for small game. The remaining material could be left in place, chipped for lining trails, or burned in the numerous stand openings.

Reduction of competition could require the reduction of the number of shrubs. This could be done mechanically, chemically, or by prescribed burning. This burn would occur before thinning because of the slash created.

c. Borax stump treatment. This alternative should be used in conjunction with a and b above to reduce the risk of introducing annosus root disease into the stand. Treatment of freshly cut conifer stumps with granular borax (sodium tetraborate decahydrate, EPA Reg. No. 1624-94) is 95% effective in preventing the establishment of new Fomes annosus centers. All conifer stumps should be cut parallel with the ground and lightly covered with dry borax according to label directions immediatley after felling.

APPENDIX

Biology of Pest Organisms

Mountain Pine Beetle

The mountain pine beetle, Dendroctonus ponderosae, attacks the bole of ponderosa, lodgepole, sugar and western white pines larger than about 4 inches dbh. Extensive infestations have occurred in mature lodgepole pine forests. Group killing often occurs in mature forests and young overstocked stands of ponderosa, sugar and western white pines.

The life cycle of the mountain pine beetle varies considerably over its range. One generation per year is the general rule, with attacks occurring from late June through August. Two generations per year may develop in low elevation sugar pine.

Attacks may extend from the root collar up to near the top. Pheromones released during a successful attack may attract enough beetles to result in the death of neighboring trees (group kill). Pitch tubes and red boring dust in bark crevices or on the ground indicate successful attacks.

The adults bore long vertical egg galleries and lay eggs in niches along the sides of the gallery. A "J"-hook is common at the lower end of the gallery. The hatching larvae feed in mines perpendicular to the main gallery and construct small pupal cells at the end of these mines where they pupate and transform into adults.

The sapwood of successfully attacked trees soon becomes heavily bluestained. The bluestain fungi probably aid in overcoming the defenses of the host tree.

Natural factors affecting the abundance of the mountain pine beetle include low winter temperatures, nematodes, woodpeckers and predaceous and parasitic insects. As stand susceptibility to the beetle increases because of age, overstocking, diseases or drought, the effectiveness of natural control decreases and tree mortality increases. Relieving stress by thinning dense stands can prevent some group kills. Individual high value trees undergoing temporary reversible stress may be protected from attack by application of insecticide to the bole.

Western Pine Beetle

The western pine beetle, Dendroctonus brevicomis, breeds in the main bole of living ponderosa and Coulter pine larger than about 4 inches dbh. Normally it breeds in trees weakened by drought, overstocking, root disease, dwarf mistletoe or fire.

Adult beetles emerge and attack trees continuously from spring through fall. Depending on the latitude and elevation, there can be from one to four generations per year. Initial attacks are made about mid-bole and subsequent attacks fill in above and below. Pheromones released during a successful attack attract other western pine beetles. Attacking beetles may spill over onto

nearby apparently healthy trees and overwhelm them by sheer numbers. Pitch tubes and red boring dust are indications of successful attacks.

Adults bore a sinuous gallery pattern in the cambium and the female lays eggs in niches along the sides. The larvae feed in the inner bark for a short distance and then turn into the outer bark to complete development.

Bluestain fungi introduced during successful attacks probably contribute to the rapid tree death associated with bark beetle attacks.

Woodpeckers, predaceous beetles and low winter temperatures cause natural control. Silvicultural activities that result in rapid, vigorous tree growth increases tree resistance and prevents mortality. Individual high value trees undergoing a temporary reversible stress, such as drought, can be protected for up to a year by applying insecticides to the bole.

Pine Engraver Beetles

Pine engraver, Ips spp., attacks have been recorded on most species of pines in California. These beetles kill saplings, poles and sawtimber up to about 26 inches dbh and the tops of even larger trees. Attacks on live trees are usually limited to trees which are suppressed, or stressed by dwarf mistletoe, root disease, drought, fire or the attack of other insects. If fresh slash is available in the spring, pine engravers may build up in an area and cause localized mortality or top killing by mid-summer.

Attacks are made with the coming of warm weather in the spring. Attacking males bore nuptial chambers in the inner bark and release a pheromone which attracts other beetles to the attack site. If many beetles are attracted, they may attack nearby trees and cause a group kill. Within a day or two of the attack by the male, two to five females enter the nuptial chamber and after mating, each female bores an individual egg gallery which lightly scores the sapwood. The size and pattern of the combined gallery pattern is often diagnostic of the species of Ips involved. The galleries are kept open by beetles pushing boring dust out through the entrance hole. Red boring dust collecting in bark crevices or spider webs is diagnostic of a successful attack. Eggs are laid in niches along the sides of the galleries. Larvae hatch from the eggs and feed in the phloem. They eventually pupate in cells at the end of their larval mines and transform to adults.

A new generation is produced in as little as 6-8 weeks in the spring to 4-6 weeks in mid-summer (August). Thus, several overlapping generations per year may be produced. The winter may be passed in any of the life stages of larvae, pupae, or adults, depending upon which Ips species is involved.

Outbreaks in standing, healthy trees are sporadic and of short duration, and are often associated with some temporary stress or shock afflicting the host species, such as drought or logging disturbance. Tree killing frequently occurs where green pine slash, which serves as breeding habitat, is left untreated during spring and summer. To be suitable as pine engraver breeding habitat, pine slash must have bark from 1/8 to 1 inch thick (usually material 3 to 26 inches diameter), must have succulent cambium and must remain moderately cool during the development period.

California Flatheaded Borer

The California flatheaded borer, Melanophila californica, principally attacks Jeffrey and ponderosa pines, although it may be found in other pines.

It is most severe in stands located on sites where environmental stress is common. Decadent or unhealthy trees are most frequently attacked, along with an occasional top of a thrifty, vigorous tree.

Eggs are laid in bark crevices of the host tree. Newly hatched larvae penetrate directly through the bark to the phloem. Here the larvae may feed from a few months to 4 years without any apparent effect on the host tree. Should host vigor and larval abundance not allow them to succeed, the larvae cut very short galleries before they die. These galleries do not seriously injure the tree and are overgrown by the cambium. Should conditions be, or become, favorable for the larvae and unfavorable for the tree, the larvae develop rapidly and destroy the cambium.

Although this insect can kill trees weakened by dwarf mistletoe and root disease, its primary importance is rendering trees increasingly susceptible to bark beetles.

Annosus Root Disease of Pine

Fomes annosus is a fungus that attacks a wide range of woody plants, causing a decay of the roots and lower bole and death of sapwood and cambium. All pines in California are susceptible; hardwoods are rarely affected.

The fungus becomes established in freshly cut stumps from air-borne spores produced by fruiting bodies (conks). It then grows into the root system and may spread to adjacent healthy trees via root contacts. Infected pines are usually killed rather rapidly when F. annosus girdles the root collar. After a suitable period of time, conks are produced under the bark of dead trees, in decayed stumps, or in the duff at the root collar.

Local spread of F. annosus outward from a stump results in the formation of disease centers that have dead trees in the middle and dying trees on the margin. These centers usually continue to enlarge until they reach barriers such as openings or groups of non-host plants. The fungus may remain alive for as long as 50 years as a saprophyte in infected roots and stumps. Pines may seed in or be planted in centers and survive for a few years, but they eventually will be infected and die.

Black Stain Root Disease

Black stain root disease is caused by the fungus Ceratocystis wageneri (asexual state Verticicladiella wageneri). In California, the fungus has three host-specific strains that infect either ponderosa and Jeffrey pine, singleleaf pinyon pine, or Douglas-fir. In most situations, the fungus does not cross-over between species, even in mixed species stands.

Initiation of disease centers probably occurs when spore-carrying, cambium-feeding beetles invade tree roots and transmit the spores of the fungus to the tree. The fungus then grows in the wood of the root toward the root collar.

Once the fungus becomes established in a tree, it spreads locally between trees through rootlet contact or fungus growth through the soil for short distances and direct infection of small feeder roots. The rate of underground spread in a ponderosa pine stand is highly variable and dependent on species composition, stand density, and site; on the Georgetown Divide, El Dorado County, the average annual radial spread was 4 feet (range 0 to 20 feet). The rate is not substantiated for Douglas-fir, although it appears to be faster than in pine.

The disease can be identified in a tree by the dark brown to black stain of the wood. This stain occurs as arcs that follow the annual rings. The amount of stain around the bole varies among trees. It may involve only a small part of the tree's circumference up to all of it. The stain may be one to many annual rings deep.

Infected trees undergo gradual to rapid crown decline prior to mortality. Symptoms of crown decline include reduced terminal growth, needle yellowing and shortening, and premature loss of foliage. Trees pole-size and larger may also bear a heavy cone crop. Bark and engraver beetles can successfully attack and kill infected trees. Douglas-firs may have grayish-blue resin streaming from the bark above the stained area.

Little information is available on stand and site characteristics associated with the disease. On the Georgetown Divide, pure or predominantly ponderosa pine stands with moderate to high stand densities had a higher probability of being infected. The disease appeared to be limited to an elevational band of 4000 to 5000 feet. A characteristic of the disease in Douglas-fir is its higher incidence along roads and in young plantations or dense natural regeneration.

Figure 1. Caldwell Butte Blad Eagle Roost Area. Solid areas, communal roost sites (55 ac); dotted lines, suspected or undefined communal roost sites (70 ac); dashed line, heavy use daytime perching area (1900 ac); solid line, moderate daytime perching area; slashed line, undefined perching boundary. Crosshatch is private land.

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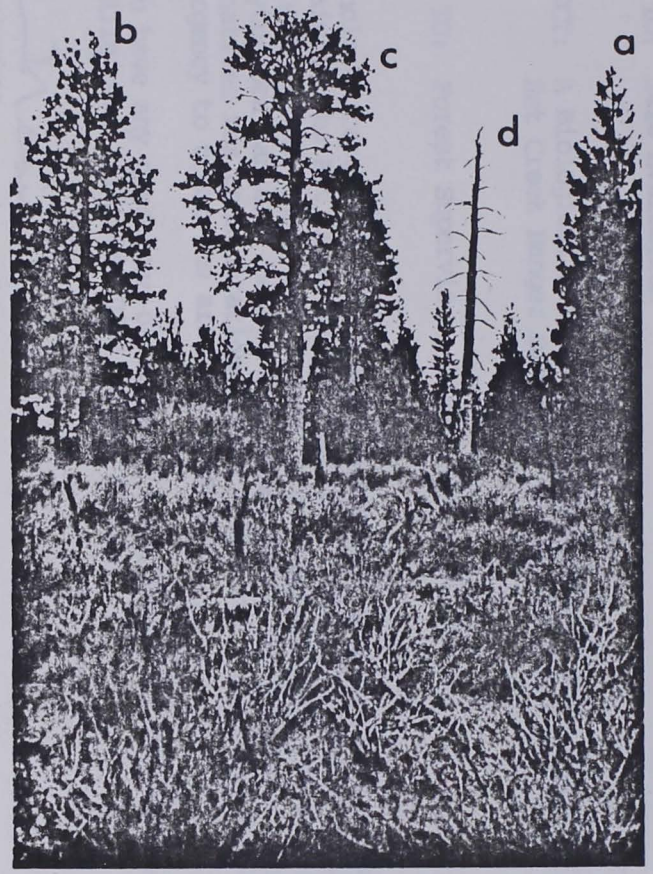

Figures 2-3. (2) Eagle roost/perch tree, Caldwell Butte, Lava Beds National Monument. (3) Crown decline of pines, Caldwell Butte, Lava Beds N. M. Vigorous crown (a), flat crown (b), top or sections of crown dying or dead (c & Fig. 2), tree death, limby snag (d), broken, limbless snag.